EFFECT OF SPRAYING BA AND ZN AT VEGETATIVE AND ROOT SYSTEM GROWTH OF PLUM SAPLINGS

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ABSTRACT

This study was aimed to investigate effects of Benzyl Adenine and Zinc sulfate on Plum trees growth, at the field of Depart. Horticultural and Landscape, College of Agricultural Engineering Sciences, University of Baghdad, during the spring season of 2021. Spraying three different concentrations (0, 50, and 100) mg.L^{-1} of Benzyl adenine and foliar applications of Zinc sulfate with three different concentrations (0, 25, and 50) mg.L^{-1} on vegetative and root system traits, as well as the chemical content of Plum seedlings (*Prunus domestica* L.) grafted on to Apricot rootstocks. The experiment conducted using factorial experiment with a Randomized Complete Block Design and, three replicates, Two seedlings per treatment, were used. The results revealed significant differences concerning the foliar application of Benzyl Adenine, particularly at the 100 mg/L concentration. which had a substantial impact on various vegetative traits. Additionally, it exhibited a superior effect on root characteristics.. Conversely, Zinc element demonstrated significant superiority at the concentration of 50 mg/L concerning the same vegetative and root traits,.

Key words: leave area, root volume, chlorophyll, carbohydrates, magnesium.

تأثير الرش بالبنزل ادنين و الزنك في نمو النظام الخضري والجذري لشتلات الاجاص

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المستخلص

هدفت هذه الدراسة لمعرفة تأثير البنزل ادنين و كبريتات الزنك على نمو اشجار الاجاص, تم تنفيذ تجربة في مشتل لقسم البستنه وهندسة الحدائق، كلية علوم الهندسة الزراعية، جامعة بغداد ,(الجادرية) خلال موسم الربيع 2021. لهدف معرفة تأثير الرش للبنزل أدينين بثلاث تراكيز مختلفة (0، 50، و 100) ملغم.لتر$^{-1}$والرش الورقي لكبريتات الزنك بثلاث تراكيز مختلفة (0، 25، و50) ملغم.لتر$^{-1}$ على صفات النمو الخضرية والجذرية لنباتات الاجاص (*Prunus domestica* L.) المطعمة على اصل المشمش البذري. نفذ البحث بتجربة عاملية ضمن تصميم القطاعات العشوائية الكاملة (RCBD)، حيث تضمنت عاملين، وثلاث مكررات، ونباتين لكل معامل. أظهرت النتائج اختلافات بين المعاملات بالرش الورقي للبنزل أدينين على الأوراق، وبخاصة عند تركيز 100 ملغ.لتر$^{-1}$، حيث كان له تأثير كبير على اغلب الصفات الخضرية. بالإضافة إلى ذلك، أظهر تأثيرًا معنويا على الصفات الجذرية، كما أظهر عنصر الزنك تفوقًا كبيرًا عند تركيز 50 ملغ.لتر$^{-1}$ بالنسبة لنفس الصفات الخضرية والجذرية، بالإضافة إلى محتوى الاوراق من المواد الكيميائية.

الكلمات المفتاحية: مساحة ورقية, حجم الجذر, الكلوروفيل, كربوهيدرات, المغنيسيوم.

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INTRODUCTION

The Prunus genus has great interest to researchers in Iraq because of the variety of varieties there that are widely consumed. (19). Prunus are a deciduous flowering trees belonging to *Rosaceae* family that includes a lot of varieties of fruit trees known plums as a common name. Plums planting in a commercially orchards, and must budding on a rootstock to grow well in a small typical space, like other *Prunus* species (14). Farmers were cut off apical bud of trees after budding plum upon a rootstock to encourage the trees for branching, because they are require well-branched maiden tree with wide angled laterals branches to provide earlier high quality fruits (24). Recently, plum growers have used growth regulators in order to increase the number of lateral branches to obtain abundant yield, with good commercial qualities. Cytokinins are the useful Phytohormones that regulating growth and development of plants (4, 15, 25). Its play basic role throughout life cycle of plants, from germination to fruit set. The interaction between several kinds of Cytokinins has a significant effect on all measured parameters, especially when used for long time, so this application is considered promising for the production of sweet cherry and plum (23). In a study conducted by (5) indicate that foliar spraying of peach plants with BA at concentration, was effective in increasing the number of shoots only. In last decades ever farmers or orchard owners think in fertilizer before planting their orchard ,because healthy trees gives perfect yield , from all trace elements Zinc essential for trees ,it's responsible for many enzymatic reactions and zinc necessary for either of growth and development (9). Reports on foliar spray of zinc to correct it's deficiencies presents variable results, zinc foliar sprays enhanced vigor, fruit set and yield in apple (20, 21). A study about accumulation Zinc in almond trees indicates that Zn will export from adjacent vegetative and woody tissue to fruiting spur, so that will accumulate in this tissue (18). This study aimed to investigate effect of BA and Zinc on the vegetative and root characteristics of plum.

MATERIALS AND METHODS

This experiment was carried out during spring season of 2021 in lathe house that affiliate to (B station) that follows to Horticultural and Landscape Design – Agricultural Engineering Sciences-University of Baghdad, A Factorial experiment was conducted using RCBD design within three replicates, with two factors applied on plum saplings that budding upon apricot seedlings as a rootstock, the sapling bought from trusted nurseries. The first factor was BA that spraying on plum leave in three concentrations (0, 50 and 100) $mg.L^{-1}$ encoded (B0, B1, B2), the spraying method started in 15 February 2021, spraying method replicate three times, intervals between its 15 days (13). the second factor was zinc as (zinc sulfate) it's also as foliar spray on plum leave , in three concentrations (0, 25 and 50) $mg.L^{-1}$ encoded as (Z0,Z1 and Z2) ,treatment started in 1st of February 2021 (10). Spray twice, the intervals between them 30 days. Genstat program was used to analyze the statistical results, to find significant use LSD. Experimental measurements included vegetative traits for scion such plant's height was measured with tape measure, main stem diameter measured by Vernier, number of branches and leave was manually counted, leave area distance. Rootstock's characteristics like roots number counted manually, main root diameter measured by Vernier, root volume, Dry Matter Percentage=(dry matter/fresh matter)*100. Chemical content of the plant, total chlorophyll content as (3). Percentage of carbohydrates in scion and rootstock, Joslyn method was used to estimate the amount of (11). the percentage of nitrogen in leaves was determined by Micro-Kejldahl method (6), percentage of potassium in the plant leaves estimated by flame photometer (22) the percentage of phosphorous was estimated using ammonium Molybdate, and it was measured by a spectrophotometer with 880nm wavelengths, Determination of Magnesium ($mg.kg^{-1}$, dry matter) in leaves by Atomic Absorption spectrophotometer, estimate Zinc ($mg.kg^{-1}$) in leaf extracts by Atomic Absorption spectrophotometer (16).

RESULTS AND DISCUSSION

Vegetative traits; the results Table (1) show that spraying plum saplings with (100$mg.L^{-1}$

)BA showed superiority on the other treatments in most of vegetative traits such as (plant height, shoots no., main stem diameter, leave numbers, leaves area, and of shoot dry matters), the results were (54.22cm, 11.78shoot.plant^{-1} , 16.19mm, 934.6leaf.plant^{-1}, 51.28 dcm^3, and 78.36%) respectively. spraying AB to plants increased endogenous Cytokinins that synthesized in plant tissues plastids such as (stems, leaf primordial, meristem and roots) regulating translocation adjacent tissues after moving in xylem and phloem (8).

Table 1. Effect of spraying BA and Zn at vegetative system

Treat.	Plant height	Shoot no.	Stem diameter	Leave no.	Leave area dis.	Veg. Dry weight percentage
Ba0Zn0	**38.47**	**11.00**	**12.93**	**700.0**	**38.50**	**59.47**
Ba0Zn1	**41.49**	**11.33**	**14.27**	**735.3**	**40.50**	**64.30**
Ba0Zn2	**46.92**	**10.67**	**15.13**	**770.0**	**42.33**	**72.57**
Ba1Zn0	**41.20**	**9.00**	**15.23**	**750.3**	**41.26**	**63.70**
Ba1Zn1	**46.10**	**8.33**	**13.23**	**818.0**	**44.97**	**70.70**
Ba1Zn2	**54.67**	**12.33**	**16.87**	**864.0**	**47.50**	**78.45**
Ba2Zn0	**45.36**	**10.00**	**15.97**	**825.6**	**45.40**	**70.00**
Ba2Zn1	**52.50**	**13.33**	**18.27**	**936.0**	**51.13**	**79.80**
Ba2Zn2	**64.80**	**12.33**	**14.33**	**1042.3**	**57.33**	**85.30**
LSD Ba×Zn	**1.494**	**4.298**	**5.360**	**1.899**	**0.4149**	**3.302**
Ba0	**42.29**	**11.00**	**14.11**	**735.1**	**40.44**	**65.45**
Ba1	**47.32**	**9.89**	**15.11**	**810.7**	**44.58**	**70.95**
Ba2	**54.22**	**11.78**	**16.19**	**934.6**	**51.28**	**78.36**
LSD Ba	**0.863**	**2.482**	**3.094**	**1.096**	**0.2395**	**1.906**
Zn0	**41.67**	**10.00**	**14.71**	**758.6**	**41.72**	**64.39**
Zn1	**46.70**	**11.00**	**15.26**	**829.7**	**45.53**	**71.60**
Zn2	**54.22**	**11.67**	**15.44**	**892.1**	**49.05**	**78.77**
LSD Zn	**0.863**	**2.482**	**3.094**	**1.096**	**0.2395**	**1.906**

Cytokinins had a perfect role in plant life cycle, started from germination to fruit set (22). The same table show that spraying plum leaves the same table shows with 50mg.L^{-1} of Zinc Sulfate was superior to other treatments in all vegetative traits (plant height, shoots no., main stem diameter, leaves no., leaves area distance, and percentage of shoot dry matter)**.** that results were 54.22cm, 11.67shoot.plant^{-1}, 15.44mm, 891.1leaf.plant^{-1}, 49.05dcm^3, and 78.77% respectively, Zinc necessary for the growth and production of plants because it is required in all tissues that take part in photosynthesis and plants need it in cell division and chlorophyll synthesis (1). According to Table (1), there were differences between the interaction factors for vegetative traits ,noticed the interaction treatment (Ba2Zn2) than other treatments in traits, like some (plant height, leave no., leave area distance, and percentage of shoot dry matter) ; 64.80cm, 1042.3leaf.plant^{-1}, 57.33 dcm^3, and 85.30% respectively. While the treatment (Ba2Zn1) showed superior significantly in (shoot no., and main stem diameter) comparative with other treatments, the results were 13.33shoot.plant^{-1}, and 18.27mm respectively

Root traits; Data in to Table (2) shows a significant effects of spray BA on plum saplings on root traits especially in 100mg.L^{-1} concentration upon (roots volume, root numbers., main root diameters, and percentage of root dry matter); the results were 146.3ml^3, 4.416root.plant^{-1}, 23.16mm, and 84,82% respectively. BA with adding externally to the vegetative traits it's stimulates internal synthesis in each shoots and roots, It was noticed symptoms of its effect in form of an increase in the number of roots, enhancing root diameter and volume, by increased cell division in the tissues that were exposed to its addition, root produced Cytokinins coordinate shoot: root resource distribution and are important to plant nitrogen status (16) The same Table mentioned that plum saplings sprayed with 50mg.L^{-1} of Zinc sulfate state superiority on other treatments in most root characteristics (root volume, root no., main root diameter, and percentage of root dry

matter) than results were (141.6 ml^3, 4,480rtto.$plant^{-1}$, 23.01mm, and 85.23%) respectively, The effects of Zinc on the vital activities inside the plant, has two aspects. The first is direct, because its affects the absorption of microelements due to its effect on active absorption in cells, which increases the movement of nutrients within the roots. It also active in the process of chlorophyll synthesis, which enhancing carbohydrates synthesis process and increases cell division, especially in roots, It is reflected to the Cytokinins synthesis that lead to an increases in the volume, length and diameter of the roots (7). As for the interaction among the factors of experiment shows a significant effect on root traits especially the treatment (Ba2Zn2) that Superior on other treatments in most traits such (root volume, root no., main root diameter, and percentage of root dry matter) that their results were (157 ml^3 , 5.113root.$plant^{-1}$, 26.48mm, and 89.65%) respectively.

Table 2. Effect of spraying BA and Zn at root system

Treatment	Root vol. ml^3	Root no.	Root diameter mm	Root . Dry weight percentage
Ba0Zn0	115.0	3.320	17.00	53.54
Ba0Zn1	125.0	3.653	17.59	64.70
Ba0Zn2	130.0	4.033	19.87	79.82
Ba1Zn0	127.0	3.500	18.87	70.05
Ba1Zn1	132.0	3.767	20.26	77.77
Ba1Zn2	137.9	4.293	22.70	86.23
Ba2Zn0	139.0	3.833	20.00	77.03
Ba2Zn1	143.1	4.300	23.00	87.78
Ba2Zn2	157.0	5.113	26.48	89.65
LSD Ba×Zn	2.210	0.1195	1.182	0.1998
Ba0	123.3	3.669	18.15	66.02
Ba1	132.3	3.853	20.61	78.02
Ba2	146.3	4.416	23.16	84.82
LSD Ba	1.276	0.0690	0.683	0.1154
Zn0	127.0	3.551	18.62	66.87
Zn1	133.3	3.907	20.28	76.75
Zn2	141.6	4.480	23.01	85.23
LSD Zn	1.276	0.0690	0.683	0.1154

Leaves chemical content; results in Table (3) show we note that spraying plum saplings with BA led to an increases in the content of leaves chlorophyll, Phosphorous and Potassium and increase in the vegetative traits content of carbohydrates, at 50mg.L^{-1}concentration, results were (40.74mg.L^{-1} fresh wet, 9.22%, 0.3320%, 1.714%) respectively.

Table 3. Effect of spraying BA and Zn on chemical content in leave

Treatment	Chlorop.	Carbo. In veg.	Carbo. in root	Nitrogen %	Phosphorous %	Potassium %	Zinc mg.L^{-1}	Magnesium
Ba0Zn0	34.38	7.08	7.80	1.168	0.2487	1.435	17.75	0.2167
Ba0Zn1	35.75	7.23	8.42	1.186	0.2577	1.502	18.10	0.2337
Ba0Zn2	38.61	7.37	9.51	1.198	0.3057	1.599	19.36	0.2627
Ba1Zn0	37.35	8.34	8.34	1.178	0.2727	1.559	17.88	0.2507
Ba1Zn1	39.22	9.14	9.34	1.188	0.2907	1.694	18.28	0.2573
Ba1Zn2	45.65	10.17	11.03	1.203	0.4327	1.889	20.13	0.3053
Ba2Zn0	35.58	7.58	9.75	1.173	0.2600	1.485	19.31	0.2757
Ba2Zn1	37.18	8.02	10.64	1.184	0.2717	1.584	20.08	0.2947
Ba2Zn2	41.69	8.55	13.12	1.272	0.3637	1.726	20.28	0.3637
LSD Ba×Zn	0.7047	1.375	1.873	0.1844	0.0560	0.2777	3.470	0.0506
Ba0	36.25	7.23	8.57	1.184	0.2707	1.512	18.40	0.2377
Ba1	40.74	9.22	9.57	1.189	0.3320	1.714	18.76	0.2711
Ba2	38.15	8.05	11.17	1.210	0.2984	1.598	19.89	0.3113
LSD Ba	0.4069	0.794	1.081	0.1065	0.0323	0.1603	2.004	0.0292
Zn0	35.77	7.67	8.63	1.173	0.2604	1.493	18.31	0.2477
Zn1	37.39	8.13	9.46	1.186	0.2733	1.593	18.82	0.2619
Zn2	41.99	8.70	11.22	1.224	0.3673	1.738	19.92	0.3106
LSD Zn	0.4069	0.794	1.081	0.1065	0.0323	0.1603	2.004	0.0292

(naturally produced Cytokinins which nitrogen-rich molecules that contain either aliphatic or equal aromatic side chains, and which encourages increased chlorophyll synthesis, which leads to polarization and aggregation of chemical elements as happened in our experiment (2) while the concentration 100mg.$L^{-1}$of BA increased the content of nitrogen ,Zinc and Magnesium in plant leaves and increases in the content of total carbohydrates in the root traits, there results were, 1.210%, 19,89mg.kg^{-1}, 0.3113mg.kg^{-1}, and 11.17% respectively. in the case of spraying plum saplings with zinc sulfate, we noticed the superiority of treatment 50mg.L^{-1}(Zn2) on other treatments in most chemical characteristics such as chlorophyll, nitrogen, phosphorous, potassium, zinc, magnesium , carbohydrates in vegetative and root system. There results were (41.99 mg.l^{-1} fresh wet, 1.224%, 0.3673%, 1.738%, 19.92 mg.kg^{-1}, 0.3106 mg.kg^{-1}, 8.70%, and 11.22%) respectively. (Micronutrients deficiency is one of the most factors that impact the movement of micronutrients in fruit trees causes a wide economic loss in fruit production (12), so this experiment showed that adding micronutrients causes significant increases in most of chemical traits especially chlorophyll content and nitrogen (2). while the results conflicted at the interactions, the results revealed that the treatment (Ba1Zn2) outperformed on other treatments in four traits chlorophyll , phosphorous and potassium in leave content and carbohydrate of shoot traits , the results were (45.65 mg.l^{-1} fresh wet, 0.4327%, 1.889%, and 10.17%) respectively, while the treatment Ba2Zn2 superior other treatments chemical characteristics such as nitrogen, zinc, magnesium in leaf content and carbohydrates in root system , the results were (1.272%, 20,28 mg.kg^{-1}, 0.3637 mg.kg^{-1}, and 13.12 %).

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